

Migrations and tree farming practices shaped the diversity of tree crops in Oceania

The example of breadfruit in Vanuatu

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The breadfruit tree *Artocarpus altilis* (Moraceae) is a perennial fruit species that contributes to food security in Oceania. Its domestication, which occurred first in New Guinea, is attributed to a shift from sexual to vegetative propagation, and its expansion in the Pacific region is closely linked to human migrations. In Vanuatu, breadfruit exhibits a high level of biological and cultural diversity, which results from a mixed system of multiplication.



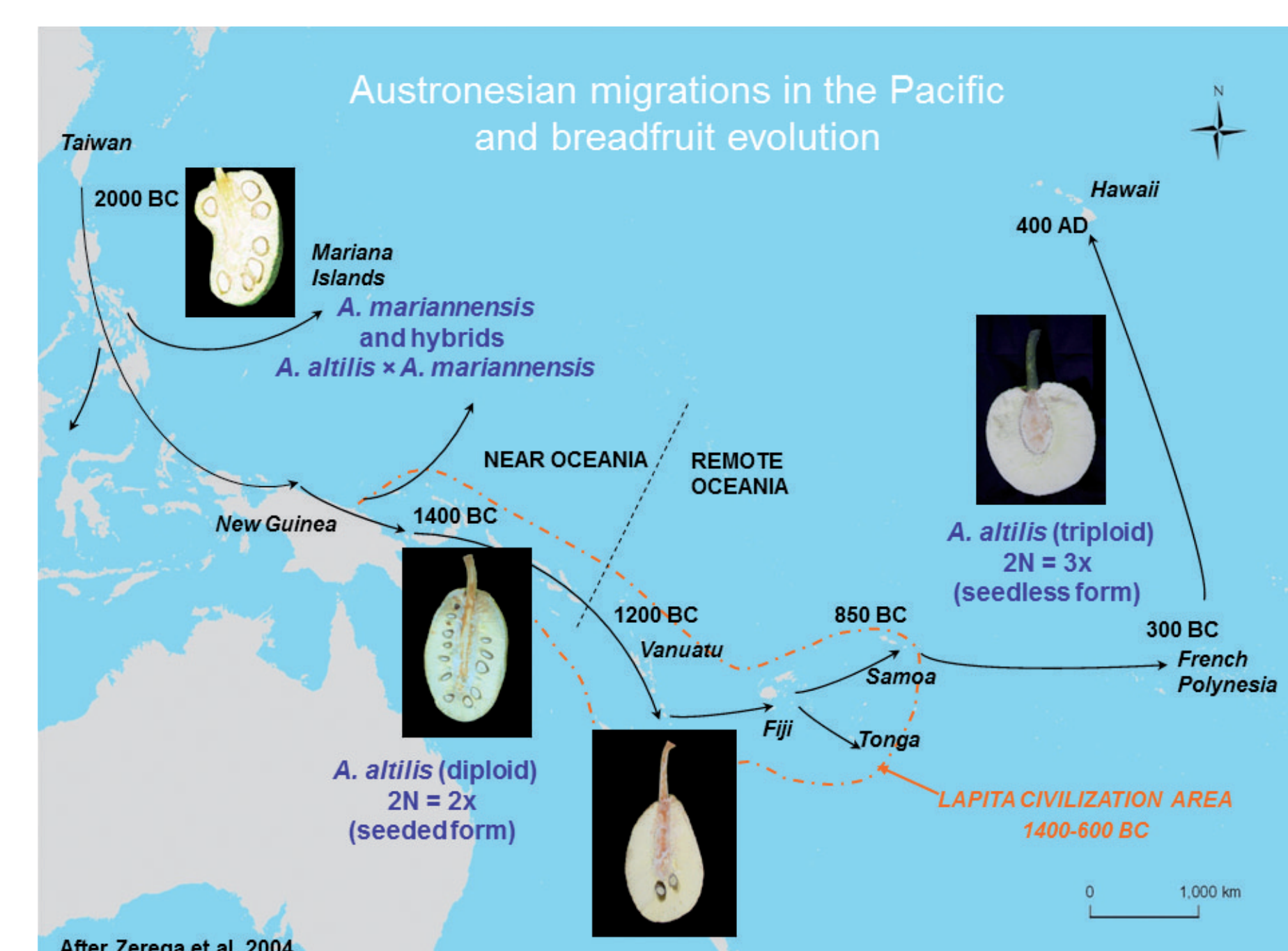
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➤ When Austronesian peoples transported landscapes

Circa 1200 BC, Austronesian peoples sailed for the first time into Remote Oceania and settled new islands that had few terrestrial food resources. To survive, they brought planting stocks of rootcrops, fruit and nut trees, and a few domestic animals as well as weeds, pests, and other 'stowaways' on their voyaging canoes, thereby transforming island biotas. Such introductions resulted in 'transported landscapes', a cultural concept that also encompasses land use and cultivation techniques^{1,2}. The Lapita civilization (1400-600 BC) expanded on the seashores of the southwest Pacific, setting up a network of exchanges of goods between distant islands. Later, with population growth, groups settled in the interior of the islands and diversified their languages and customs; however they maintained relations with their neighbours through matrimonial alliances and formalised exchanges of plants and animals.

➤ Breadfruit evolution results from human migrations and horticultural practices

In Oceania, agro-systems are dominated by rootcrop cultivation combined with a large panel of tree crops that are foraged, protected or cultivated^{3,4}. Of these, breadfruit is one of the archetypical domesticated trees of oceanic settlement. As revealed by past studies based on isozymes, DNA markers and biochemical analysis, most breadfruit cultivars found in Melanesia are fertile diploids and exhibit greater diversity than the cultivars of Remote Polynesia (French Polynesia, Hawaii), which are all seedless and vegetatively propagated^{5,6,7}. The loss of fertility can be attributed to a triploid genetic structure or, in the case of sterile diploids, to interspecific hybridization. It is assumed that such a decrease in diversity and fertility is the result of a shift from using the species as a nut crop in New Guinea, where domestication started, to a starchy crop eastwards. That evolution can be attributed to the practice of vegetative propagation developed during the domestication process by Pacific peoples in order to preserve and transport the most worthwhile cultivars over long distances by sea.



➤ In Vanuatu, breadfruit diversity is a result of a mixed clonal-sexual system of multiplication



In Island Melanesia, Vanuatu is one of the centres of diversification and domestication of the breadfruit tree, which can be found in different landscape compartments: backyards, along tracks, inside coconut plantations, on the edge of gardens, as well as in fallows and forests where breadfruit seeds are dispersed by birds and flying foxes.



Navarro *et al.*, followed by Mies, undertook ethnobotanical surveys in 33 villages located on 12 islands^{8,9}. They recorded 221 breadfruit cultivar names and found a high level of diversity in terms of morphological characteristics, as well as cultivation and multiplication techniques, cooking recipes and conservation methods, material cultural goods, and medicinal and ritual values.



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Unlike Polynesians, Vanuatu farmers have an important reservoir of diversity

at their disposal with bat- and bird- dispersed trees, or, on some islands, with seedlings resulting from voluntary farming practices¹⁰. Such sexual reproduction, with outcrossing, results in a wider variety of genotypes. By vegetative propagation, farmers select the best trees according to diverse criteria (taste, seasonality, use, etc.) and shorten the length of the juvenile phase. We suggest that such a mixed clonal-sexual system, which has already been observed in Vanuatu on cassava¹¹ and taro¹², combined with a system of fallow and forest management in interaction with gardens and tree crop stands, makes diversification of breadfruit particularly rapid, compared to other tree crops.



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➤ Further ethnobiological studies are needed

Advanced genomic tools such as DNA microsatellite markers are known to be particularly efficient for analysing the structure of genetic diversity and assessing parental relationships. An ethnobiological approach combining linguistic research, historical data, and genotyping of breadfruit cultivars at different levels (farmer, village, island, country) could shed light on the role of local selection and multiplication practices in the creation and the management of breadfruit diversity. It will also contribute to a better understanding of migration routes and cultural contacts between islanders.

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